spite of arctic sleeping bag and blankets and overcoats so numerous that one could hardly lift the weight in breathing. On the trips in which a second night was passed at this height, more sleep was secured, indicating that the body was getting adjusted to the altitude. The headache disappeared and the appetite revived on the return trip. On the first of these trips, records were made of the pulse and respiration, as accurately as could be made by a person upon himself. They are as follows: Aug. 18, 10 p. m., at observatory on retiring, pulse 80, respiration 16; August 19, 6.00 a. m., on rising, pulse 80, respiration 16; 3.30 p. m. at tambo de los huesos, elevation 13,300 feet, pulse 96, respiration 12; Aug. 20, 6.25 a. m., at hut 15,400 feet, on rising, pulse 90, respiration 12; 12.30 p. m., at summit, 19,200 feet, pulse 86, respiration 11; Aug. 21, 10 a. m. at hut, 15,400 feet, pulse 86, respiration 11. The rather small increase in the pulse and the decrease in the respiration are noteworthy. While I made no records on other trips, I noticed frequently that my tendency was to breathe more slowly than usual, except when moving about.

WINSLOW UPTON.

PROVIDENCE, R. I.,
December 7, 1901.

SCIENTIFIC ORNITHOLOGY.

THE following remarkable misuse of terminology occurs in Mr. Robert Ridgway's 'Birds of North and Middle America,' Part I., The Finches, just from the press of the Government Printing Office. He says in his Introduction: "There are two essentially different kinds of ornithology: *systematic*, or *scientific*, and *popular*. The former deals with the structure and classification of birds, their synonymies and technical descriptions. The latter treats of their habits, songs, nesting, and other facts pertaining to their life-histories." And he continues: "Popular ornithology is the more entertaining with its savor of the wildwood, green fields, the riverside and seashore, bird songs and the many fascinating things connected with out-door nature. But systematic ornithology, being a component part of biology—the science of life—is the more instructive and therefore the more important." And are, indeed, life-habits and life-history not biology, not, if scientifically studied, science of life, not more important than the mere forms which result from this part of bird biology? Could there be found a worse misconception of where science and popular writing differentiate!

X.

SHORTER ARTICLES.

THE RESULTS ATTENDING THE EXPERIMENTS IN LOBSTER CULTURE MADE BY THE UNITED STATES COMMISSION OF FISH AND FISHERIES.

IN April, 1900, the United States Commission of Fish and Fisheries appropriated several thousand dollars to be used in devising, if possible, a practical method of artificial lobster culture, and the undersigned was appointed to take immediate charge of the experiments.

The breeding period of the lobster, continuing as it does only through a few weeks of the late spring and early summer, is so brief that extended experiments have been impossible, but the experiments that have thus far been made (during the spring of 1900 and of 1901) would indicate that very large numbers of lobsters may be hatched and retained in captivity until they have reached an age when they are well able to take care of themselves. Indeed, it would seem that the enormous mortality among lobster young (which results either from boiling females 'in berry,' or stripping the eggs from the female as the lobsters are taken from the traps) may not only be lessened, but that the young enclosed in these eggs may, with very little expense, be hatched in the more important fishing ports and hamlets and protected until they have passed through the critical stages.

It seems advisable to defer the rendering of the final report until the Commission has profited by the experiments of another season. Inasmuch, however, as the problem is of considerable economic importance, it would seem desirable to make some report at the present time, although only a report of progress.

In the spring of 1900 a number of experiment stations were established along the New England coast, namely, at Orrs Island, Freeport, Annisquam, Gloucester, Woods Holl, Naushon and Wickford. Experiments had been made previously at Woods Holl, but without encour-

aging results, and it was thought that the establishment of several stations might result in the discovery of some locality having physical and biological conditions more favorable than those found at the government laboratory. The officers of the stations at Gloucester and Woods Holl and the officers of the *Grampus*, *Fish Hawk* and *Phalarope* cordially cooperated in the work of the special committee, but the experiments at all the stations excepting that at Wickford were discouraging. The lobster fry, even in the cold clear water of the Gulf of Maine, would soon become covered with a chenille-like growth of diatoms and would die, no matter what kind of enclosures were used.

At Wickford, however, where the Rhode Island Commission had courteously given the use of their floating house-boat, the fry seemed to find a more congenial environment. In what respects the water and the plankton at Wickford were more favorable to the fry cannot at the present time be stated; it was, nevertheless, a fact that the young taken from the hatchery at Woods Holl would quickly perish when confined at various localities near Woods Holl, but would thrive when placed in the same kind of enclosures at Wickford. The water at Wickford is rather fresh and of high temperature (often ten degrees higher than at Woods Holl). It is charged with vegetable and animal life, and the current is sufficiently strong to assist materially in the aeration of the water in the enclosures.

Many different devices for enclosures were adopted and tried. Large salt-water ponds, smaller pools, artificial pools made by the building of dikes, enclosures made of wire screen and floated and wire screen and submerged, huge canvas boxes and cars, cars of scrim floated and anchored at the bottom, glass jars of various sizes, running water in vessels of wood, metal, glass, porcelain and stone, and various rotary devices, all proved efficient agents for the killing rather than for the rearing of lobster fry.

The only enclosures which gave encouraging results were made out of scrim in the shape of huge bags some sixteen feet in diameter and several feet in depth and so leaded at the bottom that they would rise and fall with the current and agitate the enclosed fry. But the current was not sufficient at all times to keep the young lobsters from settling to the bottom, devouring one another and gathering into a confused mass of maimed and struggling individuals. At these times it was necessary for the staff at Wickford to agitate the water artificially, and this was done by the use of paddles.

To Dr. A. D. Mead, who was the director of the Wickford laboratory, is due the credit of having demonstrated the importance of keeping the young lobsters from the bottom of the enclosure, by either natural or artificial means.

Under favorable conditions the growth of the young fry is phenomenal. The first molt takes place about six days after the young have left the egg, the second molt some six days later and the third about five days later still. The third molt takes the fry into the fourth stage, when they assume the characters and habits of the adult. Under the most favorable conditions this fourth stage may be reached in nine days from the time the lobsters are taken from the hatching-jars, but under less favorable conditions, within the same enclosures, certain individuals may be found in the second stage after a lapse of several weeks. In both structure and habits the young that have reached the fourth or 'lobsterling' stage are very different from those of the previous stage. These older individuals (known at the laboratory as 'fourses') are provided with pinching-claws, hardened shell and vigorous muscles. They are very active, have a voracious appetite, and are pugnacious and secretive.

It is well known that the planting of a few young trout in the fingerling stage will accomplish much more toward restocking our streams than the planting of many thousand fry, and I think it safe to conclude that the planting of many thousands of lobsters in the 'lobsterling' stage would do much more toward rehabilitating the waning lobster industry than the planting of many millions of helpless fry as they leave the hatchery.

No special effort was made in 1900 to treat the fry after they had reached the fourth stage, but a few were retained. Those of the United States Fish Commission office at Washington have been obliged to endure the more artificial environment of an aquarium. Those at Wick-

ford have had a somewhat more natural environment, having spent the winter in a submerged crate. They are hardy, voracious and seem to thrive.

The plans for the second year were based on the successes and failures of the first, and it was thought best to take advantage of the favorable environmental conditions at Wickford, to discontinue the work elsewhere, and to put all the energy into devising some economical contrivance for keeping the water so agitated that the fry would not and could not settle to the bottom.

After many experiments, a relatively simple and inexpensive device was adopted. Several bags of scrim about three feet in diameter and four in depth were so suspended in the pool of the floating laboratory that the current could not change their general shape or cause them to collapse. In each bag was placed a dasher, the blades of which in rotation would constantly lift the water through the mesh at the bottom of the bag and urge it with obviously less velocity through the pores of the vertical walls. The dashers were kept in motion by means of a small gasolene engine, the motor apparatus as a whole having a striking resemblance to the aerating equipment of a second-class restaurant. The scrim bags looked like so many vertical cylinders. We found that when the mechanism was in actual operation the current in rising through the bottom of the bag brought with it large numbers of pelagic animals, while the reduced current of the water passing through the greater expanse of the vertical walls was not sufficient to carry this living material out of the bags; thus the apparatus sufficed not only for keeping the fry and artificial food from the bottom, but it also provided the fry with living natural food. To Mr. George H. Sherwood is due the credit of devising and installing this aerating and feed apparatus.

In practice it was found that the eggs stripped from the abdomen of the female would hatch in these scrim enclosures under much more favorable conditions than in McDonald jars. Indeed, I am inclined to believe that a far higher percentage of eggs would hatch in these bags than in the McDonald jars, and I am sure that the young are in a much more healthy condition than when hatched by the older method. Even a superficial examination of the young that have spent some hours in the trituration of the McDonald jars will show that a large proportion of them have the appendages broken, bent or indented.

The number of fry that were available for the purpose of experimentation during the first season was considerably less than in 1900, and the period of experimental work was also materially reduced. Nevertheless, Dr. Mead, who had the work immediately in charge, reports that by actual count in no case was the number of lobsters that reached the fourth stage less than 16 per cent. of the number of fry originally placed in the enclosure. In a few cases it was above 40 per cent. and in at least one case it was as high as 54 per cent. In previous years no experiments had yielded more than a fraction of one per cent. The total number of lobsters raised to the fourth stage during the season of 1901 (in the twelve cylinders) was a little more than nine thousand.

Encouraged by these results, the United States Commission of Fish and Fisheries is now planning to equip one or more stations with the aerating, hatching and brooding apparatus above described, and to actually test the feasibility of raising large numbers of fry to the fourth stage, and I feel convinced that the liberation of large numbers of these more hardy young will result in the restocking of our depleted waters.

H. C. BUMPUS.
AMERICAN MUSEUM OF NATURAL HISTORY.

ON THE STRUCTURE OF THE MANUS IN BRONTOSAURUS.

During the past season, while engaged in collecting vertebrate fossils for the Carnegie Museum, Mr. Charles W. Gilmore had the good fortune to discover in the Jurassic exposures on Sheep Creek, in Albany Co., Wyo., a very considerable portion of the skeleton of *Brontosaurus*.

This skeleton was very carefully taken up by Mr. Gilmore and has been received at the museum. Among the more important parts secured was a nearly complete fore limb and foot with the different elements for the most part still retained in their normal position, making it possible for the first time to definitely deter-